SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1986

REV. JAN2006

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Superseding J1986 FEB1993

Balance Weight and Rim Flange Design Specifications, Test Procedures, and Performance Recommendations

1. ***Scope***—This SAE Recommended Practice is intended to serve as a guide for standardization of features, dimensions, and configurations of balance weights and rim flanges for aluminum and steel wheels intended for use on passenger cars, light trucks, and multipurpose vehicles to assure good installation and retention of the balance weight on the rim flange. This document also provides test procedures and minimum performance requirements for testing balance weight retention. Alternate materials and geometries can be addressed in the future, for example adhesive balance weights.

1.1 **Rationale**—SAE J1986 was rewritten to reflect current Industry Practice and to update Procedures, Test Methods, Charts, Figures and wheel rim types.

2. ***References***

2.1 **Applicable Publication**—The following publication forms a part of the specification to the extent specified herein.

2.1.1 TIRE & RIM ASSOCIATION PUBLICATION—Available from The Tire & Rim Association, Inc., 175 Montrose West Avenue, Suite 150, Copley, OH 44321.

Tire & Rim Association Yearbook

3. ***Definitions***

3.1 **Balance Weight Assembly**—An assembly of the weight and the clip which is intended for mounting on the rim flange to balance the tire/wheel assembly about its axis of rotation and thus minimize vibrations due to the rotation of the tire/wheel assembly.

3.1.1 WEIGHT—Metal of a specified mass with contours to conform to the surface of the rim flange.

3.1.2 CLIP—Specially formed metal affixed to the weight to mount the balance weight on the rim flange.

3.1.3 SPUR—An optional part of a clip protruding from its surface interfacing with the rim flange.

3.1.4 BALANCE WEIGHT COATING—Noncorrosive material coating (e.g., polyester) to prevent corrosion.

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3.1.5 BALANCE WEIGHT KEY DIMENSIONS—Dimensions which are essential for fitting the balance weight on the rim flange.

3.1.6 BALANCE WEIGHT SIZE—The balance weight size is determined by the magnitude of the balance weight mass and is expressed in gm (oz).

3.1.7 BALANCE WEIGHT RETENTION FORCE—A static force required to remove the balance weight from the rim flange as set forth in Section 7.

3.1.8 BALANCE WEIGHT RETENTION—An ability of the balance weight to maintain its secure position on the rim flange in various service conditions on the road as well as in the laboratory.

3.1.9 INTERFERENCE—The measure of balance weight press fit computed as the difference between the flange thickness and the weight gap.

3.1.10 For further definitions and descriptions of nomenclature of balance weights see Figure 1.

3.1.11 RIM FLANGE—That part of the rim where the balance weight is mounted.

3.1.11.1 Rim Flange Key Dimensions—Dimensions which are essential for fitting the balance weight on the rim flange.

3.1.11.2 For further definitions and descriptions of nomenclature of rim flange features, see Figure 2 and Figure 3.

4. Balance Weight Assembly Types—Balance weight types are identified and marked by letter codes (Table 1). Four different types of balance weights have been evaluated and recommended for use in the industry: P, C, T, and MC (see Figure 4). Alternate balance weight types are not included.

TABLE 1—TYPICAL APPLICATION CHART BALANCE WEIGHT SELECTION

Wheel Rim Type	Weight Type	Weight Gap	Spur Depth	Flange Lip Thickness	Flange Offset
Reference Figure Number 7 Steel Rolled Flange & Light Alloy Rolled Flange	C	1.6-2.0	NA	2.0-2.7	10 ± 1.2
	P	2.0-2.4	NA	2.7-3.3	10 ± 1.2
	T	2.7-3.1	NA	3.4-4.6	10 ± 1.2
	MC	4.1-4.5	0.7-1.1	5.0-6.0	10 ± 1.2
Reference Figure Number 6 Full Face Light Alloy, Steel, Clad	T	2.7-3.1	NA	3.4-4.6	10 ± 1.2
Reference Figure Number 5 Light Alloy Machined	MC	4.1-4.5	0.7-1.1	5.0-6.0	7.6 ± .5

Note: Wheels with Flange Lip thickness or tolerances outside of the typical ranges may require different Flange Offsets to meet retention Force targets.

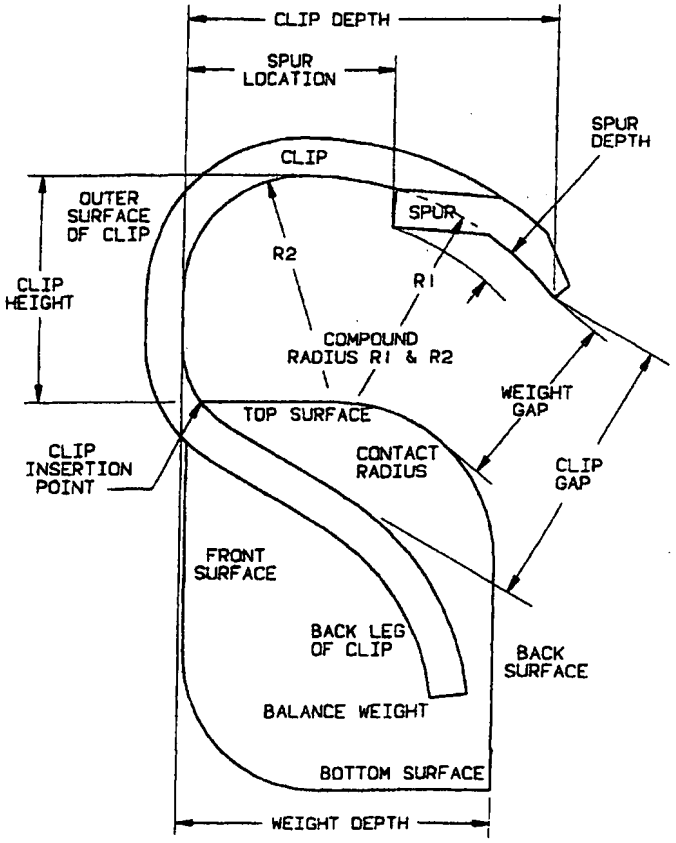
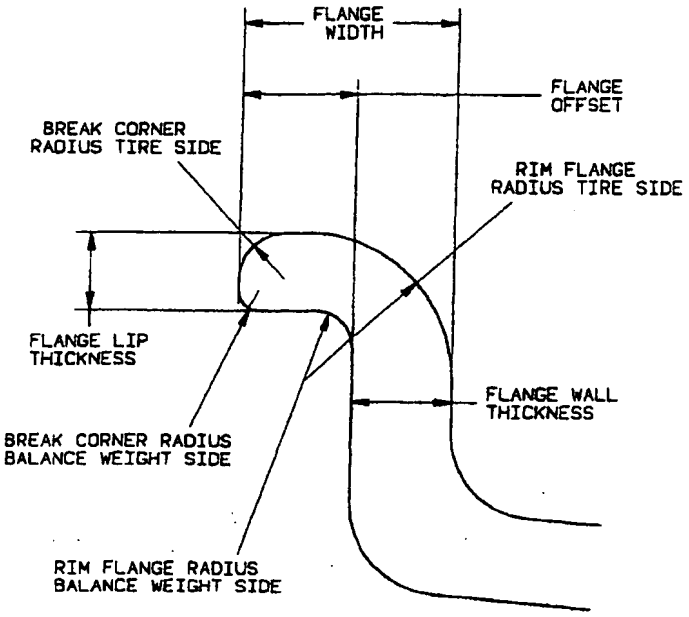


FIGURE 1—BALANCE WEIGHT ASSEMBLY TERMINOLOGY



NOTE:
TERMINOLOGY IS TYPICAL FOR INBOARD AND OUTBOARD RIM FLANGES

FIGURE 2—MACHINED ALUMINUM WHEEL RIM FLANGE TERMINOLOGY

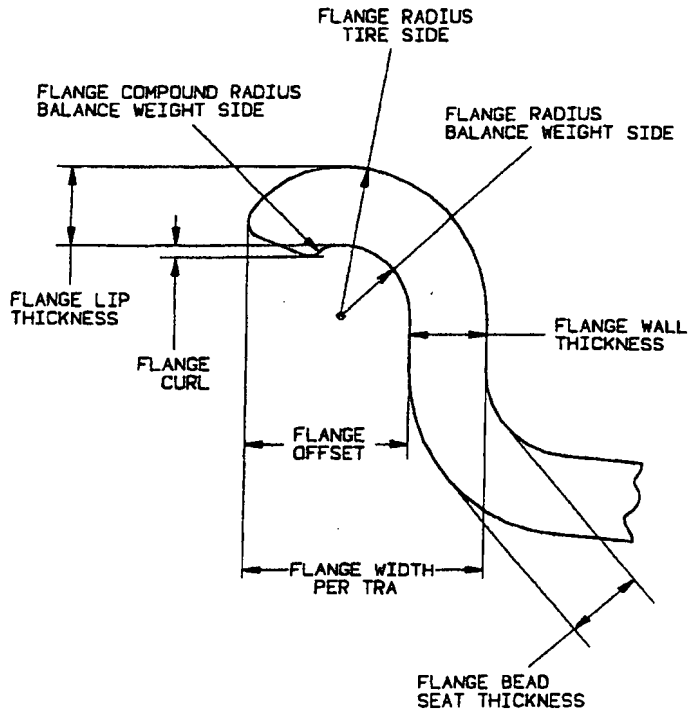


FIGURE 3—ROLL FORMED WHEEL RIM FLANGE TERMINOLOGY

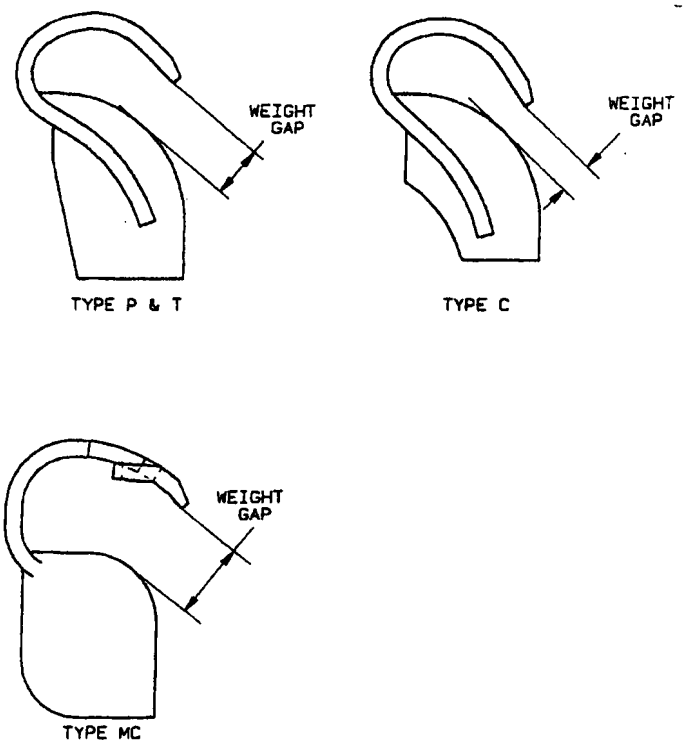


FIGURE 4—BALANCE WEIGHT ASSEMBLY TYPES

5. ***Rim Flange Types***—Rim flange types are identified by letter codes. Rim flange types covered by this document are: J, JB, and JJ. Alternate rim flange types, for example L, currently in use are not included. Configurations of these rim flanges are shown in the Tire & Rim Association (TRA) yearbook. Dimensions shown in the TRA book are limited to those pertaining to the rim flange contour on the tire side and do not include dimensions on the balance weight side. Recommended rim flange dimensions and configurations on the balance weight side are discussed in Section 6 and are shown in Figures 5, 6, and 7.

6. ***Recommended Rim Flange Features, Dimensions, and Configurations***

6.1 Light Alloy Machined—Recommended rim flange features, dimensions, and configurations are shown in Figure 5. The rim flanges shown in Figure 5 are intended for MC type balance weights.

6.2 Steel and Light Alloy Rolled Rims—Recommended rim flange features, dimensions, and configurations are shown in Figure 7 and use the "C, P, T, MC" type weights.

6.3 Fabricated, Full Face Wheels, Light Alloy Wheels—Recommended rim flange features, dimensions, and configurations are shown in Figure 6, are intended for the "T" type weight.

7. ***Balance Weight Assembly Selection***—Recommended balance weights for different rim types are shown in Table 1.

8. ***Test Procedure—Axial Removal Test***

8.1 Preparation of Balance Weights for Test

8.1.1 SELECTION OF BALANCE WEIGHTS—For each test use a set of new balance weights of different sizes representative of the wheel for which they are intended. The balance weights of each size shall be equally divided into two groups each containing the same number. For testing purposes, one group shall be mounted on the outboard flange and the other group on the inboard flange.

8.1.2 MEASUREMENTS OF DIMENSIONS OF BALANCE WEIGHTS—For balance weights intended for Light Alloy wheels, measure weight gap and spur depth (where used). For balance weights intended for steel wheels, measure weight gap only. The measured values of weight gap and spur depth shall be within design specification shown in Table 1.

8.1.3 MARKING OF BALANCE WEIGHTS—Individual balance weights of different sizes shall be picked at random from the selected group and marked by using sequential numbers. One half of the group are to be tested on the outboard flange and the other half on the inboard rim flange.

8.2 Preparation of the Wheel

8.2.1 CLEANING—Clean the surfaces of the outboard and the inboard rim flanges to remove any dirt or grease by using solvent which leaves no residue.

8.2.2 MARKING—Using a felt pen, make equally spaced marks around the circumference of the outboard and inboard flanges to indicate mounting points for each of the balance weights. The flange surface at each mounting point shall be free of scratches, gouges, and welds.

8.2.3 MEASUREMENT OF RIM FLANGE DIMENSIONS—Measure and record the following dimensions on the outboard and inboard rim flanges: Flange Lip Thickness, Flange Offset, and Flange Width for all Wheel Types and Weight lead in and optional groove location for full Face and Clad Wheels (see Figures 6 and 7). All measured dimensions shall be within design specifications shown in Figures 6 and 7.

8.3 Test Equipment—The test equipment shall be capable of removing the balance weight from the rim flange as well as measuring and reading the maximum force required to initiate movement.

8.4 Test Sequence—There are two distinct methods to evaluate axial retention. The test shall be conducted using one of the following processes:

Option 1 - Push Off Test (see Figure 8)
Option 2 - Pull Off Test (see Figure 9)

8.4.1 For Option 1, install the probe for moving the balance weight on the rim flange in the center hole of the fixture with the flat edge facing up.

8.4.2 For Option 1, install the balance weight on the inboard and outboard rim flange by using a nonmetallic hammer. Strike the balance weight in such a manner that one blow properly seats it on the rim flange. For Option 2, install weight with the wire loop under the weight clip (see Figure 9 inset).

8.4.3 Install the wheel in the test fixture and center it on the base of the fixture as shown in Figure 8 and 9.

8.4.4 For Option 1, set the probe in the center of the hole or notch located in the clip by adjusting its horizontal, vertical, and angular positions while avoiding contact with the rim flange during test sequence. For Option 2, connect the wire loop to the force indicator.

8.4.5 Set the force indicator on the test equipment to zero.

8.4.6 Gradually increase the force on the lever until the balance weight moves. Record the maximum indicated force.

8.4.7 Discard the balance weight removed from the rim flange and do not use it in future testing.

8.4.8 Reset the wheel for the next position of balance weight removal.

8.4.9 Repeat steps 8.4.2 through 8.4.8 for each balance weight installed on the inboard and outboard rim flange using small, medium, and large weights (10 weights per side minimum).

8.5 Calibrate load cell using 10 kg (25 lb) increment weights up to 45 kg (100 lb).

9. Performance Requirements—The minimum value of balance weight retention force determined in accordance with the Static Test procedure described in Section 8 is shown on Table 2.

TABLE 2—BALANCE WEIGHT AXIAL – FORCE VALUES

Mass (g)	5	10-15	20, 25, 30, 35	40-80	≥90
Min. Force (N)	50	60	150	200	300

10. A Tangential Test Procedure and Performance Requirements will be evaluated by the Balance Weight Committee.

11. Notes

11.1 Marginal Indicia—The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

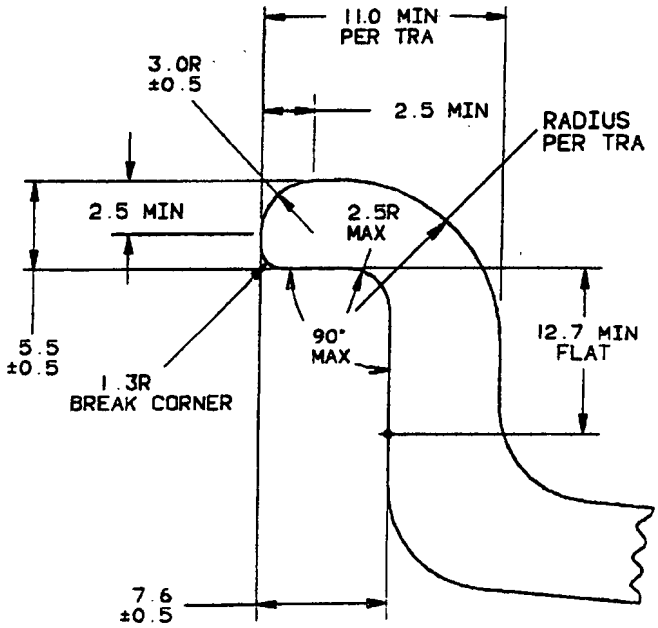


FIGURE 5—RECOMMENDED FLANGE DESIGN PRACTICE MACHINED ALUMINUM WHEELS
"MC" TYPE BALANCE WEIGHT

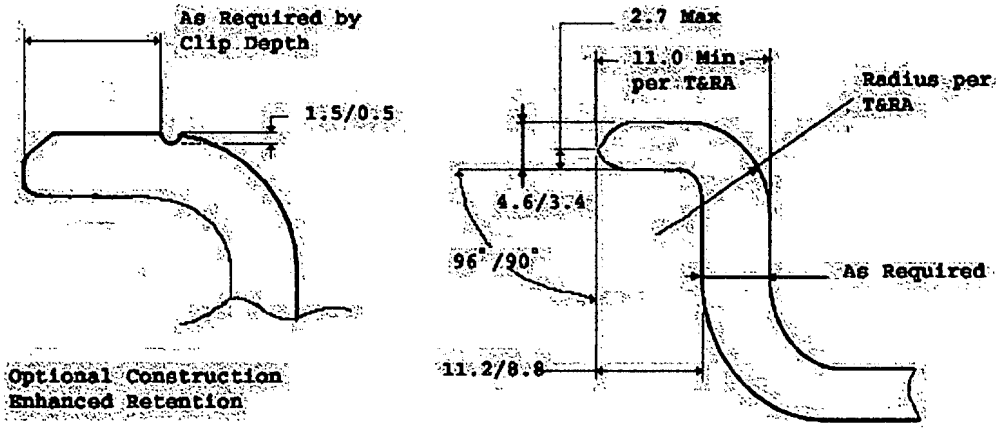
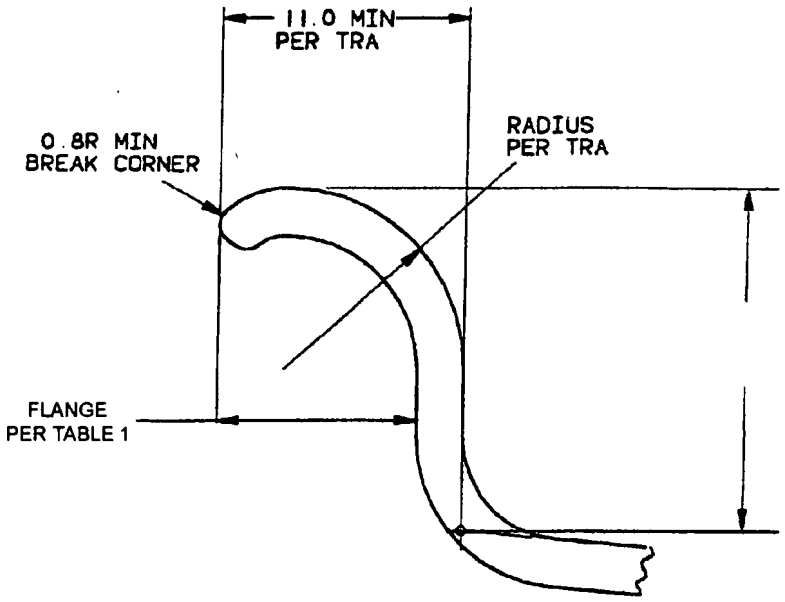


FIGURE 6—RECOMMENDED FLANGE DESIGN PRACTICE FULL FACE,
LIGHT ALLOY, STEEL, CLAD WHEELS "T" TYPE BALANCE WEIGHT



NOTES:
FOR SPECIFIC RIM FLANGE DIMENSIONS
REFER TO INDIVIDUAL WHEEL DRAWING

FIGURE 7—RECOMMENDED FLANGE DESIGN PRACTICE STEEL AND LIGHT ALLOY ROLLED WHEELS "C, P, T, MC" TYPE

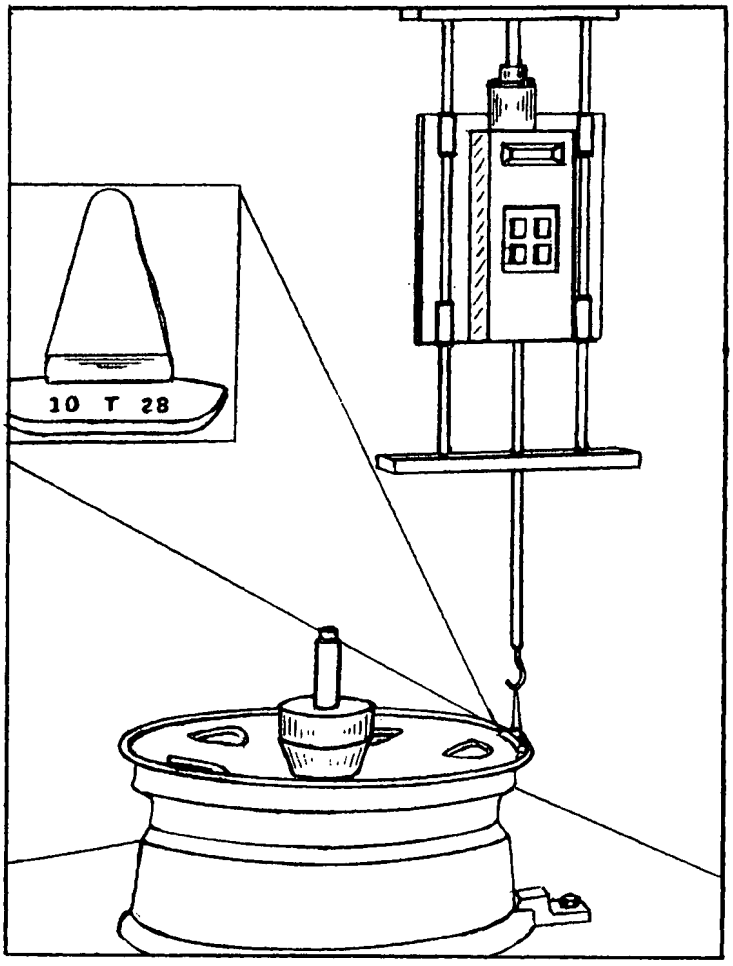


FIGURE 9—PULL OFF TEST FIXTURE

PREPARED BY THE SAE WHEEL STANDARDS COMMITTEE BALANCE WEIGHT TASK FORCE

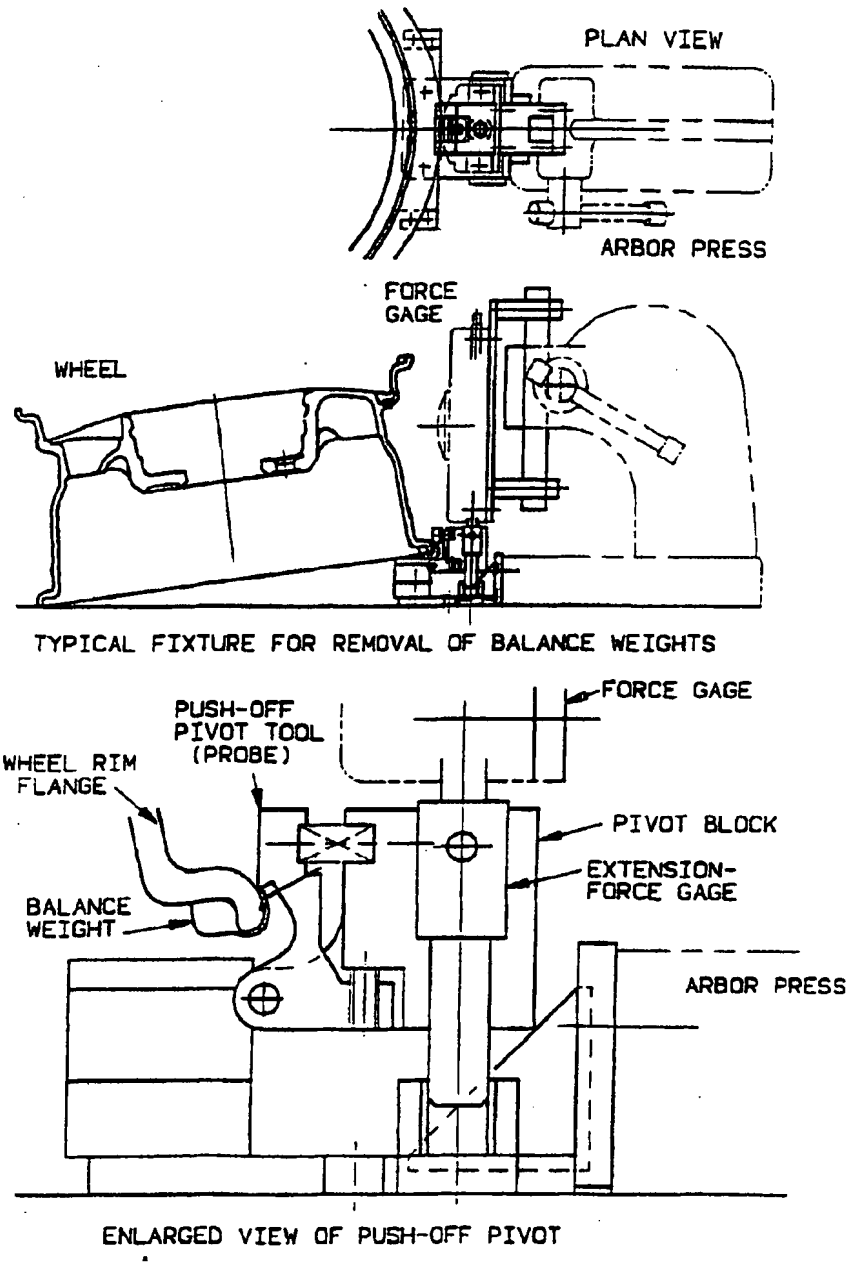


FIGURE 8—TYPICAL FIXTURE FOR REMOVAL OF BALANCE WEIGHTS AND ENLARGED VIEW OF PUSH-OFF PIVOT